AMENDED SPECIFICATION

Reprinted as amended under Section 8 of the Patents and Designs Acts, 1907 to 1942.

PATENT SPECIFICATION

Application Date: Sept. 25, 1942. No. 13497/42. **556,538**

Complete Specification Left: April 14, 1943.

Complete Specification Accepted: Oct. 8, 1943.

PROVISIONAL SPECIFICATION

Improvements in or relating to Differential Pistons

We, CECIL CYPRIAN HIGGENS, a British Subject, and THE EYRE SMELTING COMPANY LIMITED, a British Company, both of Tandem Works, Merton Abbey, London, S.W.19, do hereby declare the nature of this invention to be as follows:—

This invention relates to differential pistons and has for its object to provide improvements therein.

In accordance with the present invention we provide a differential piston arrangement wherein the pistons are separate members, and are not rigidly connected as is usual.

Suitable means may be provided for keeping the pistons in operational contact. The piston chambers or bearings may be formed in one piece.

In one form of device made in accordance with the present invention, the differential piston arrangement comprises two separate coaxial pistons of the requisite diameters, sliding in cylindrical coaxial piston chambers or bearings of the necessary bore. The piston of the larger diameter abuts directly on the piston of the smaller diameter. The piston of the smaller diameter may have a hemispherical end where it makes contact with the larger piston's end. The free end of the piston of small diameter is provided with a flanged member which abuts on a compression return spring suitably housed and tensioned to keep the two pistons always in contact. The bearings of the pistons are formed from an integral member and at their junction are provided with suitable inlet and outlet orifices, ducts and valves. A suitable cam acts on the free end of the piston of larger diameter against the action of the beforementioned spring.

In use on operating the cam, the differential piston sucks fluid through the inlet into the chamber formed by the end space of the bearing of the piston of larger diameter when the latter is withdrawn and on the return stroke of this piston expels the fluid through the outlet.

As the two pistons are separate members, the problem of the alignment of the bearings is much simpler than if the pistons were integrally connected.

Further, the production of a piston with two or more truly coaxial portions of differing diameters integrally connected together may, under certain circumstances, be both a difficult and costly matter, whereas single pistons having only one working diameter are easily and cheaply manufactured in any reasonable size to a high degree of accuracy.

It will be evident that there may be more than two differential pistons and that the details of the invention may be varied in many ways without departing from the scope of the invention.

Dated this 25th day of September, 1942.

HARDINGHAM & URQUHART DYKES,
75, Chancery Lane, London, W.C.2
Chartered Patent Agents.

COMPLETE SPECIFICATION

Improvements in or relating to Differential Pistons

We, CECIL CYPRIAN HIGGENS, a British Subject, and THE EYRE SMELTING COMPANY LIMITED, a Company incorporated under the Laws of Great Britain and Northern Ireland, both of Tandem Works, Merton Abbey, London, S.W,19, do hereby declare the nature of this invention and in what manner the same is to be performed to be particularly described and ascertained in and by the following statement:—

This invention relates to differential

[*Price* 1/-]

pistons such as are used in certain types of plunger pumps and has for its object the simplification and reduction in cost of the construction thereof.

In accordance with the present invention we provide a differential piston construction wherein the pistons of different diameters are separate members and the piston of the larger diameter abuts directly on the piston of smaller diameter, means being provided for pressing the pistons together in operational connection, the pistons sliding in cylindrical piston chambers or bearings of suitable bore and the piston of the smaller diameter has a hemispherical end where it makes contact with the larger piston or *vice versa*. At the junction of the two piston chambers suitable inlet and outlet orifices, ducts and valves are provided. The free end of the piston of smaller diameter abuts on a compression return spring suitably housed and tensioned to keep the pistons always in contact. A cam acts on the free end of the piston of larger diameter against the action of the before-mentioned spring.

One form of device made in accordance with the invention is hereunder described with reference to the figure in the diagrammatic drawing, wherein is shown in cross section a differential-plunger type of pump.

In the form of construction illustrated in the drawing we provide a body having an outlet end 101, and an inlet end 101A, and which may consist of a casting or any other convenient form of manufacture. The body has a bore 101B. The suction inlet is by a passage 101C, and the delivery by a passage 101D, both of which passages lead into the appropriate valve chambers. The body 101A/101 contains foot and delivery valves 102, 102A. The passage 101E connects suction passage 101C with spring chamber 101F, which is closed with a removable cap 103. The foot valve chamber is sealed by cap 104, and the delivery valve chamber by plug 105. Within the bore 101B there is disposed a plunger guide member 106, containing two piston chambers 106A and 106B of suitable diameters together with a faced end flange 106C for enabling the guide member to be held firmly within the bore. At the junction of the two piston chambers 106A and 106B in the member 106 holes 106D and 106E are drilled and register respectively with the foot and delivery valve members 102 and 102A. In a recess 107 coaxial with the bore 101B there is disposed a locking member 108. Sliding within the piston chamber 106A is a plunger or piston 109 provided with sealing grooves 110. Another separate plunger or piston 111, of smaller diameter than piston 109, slides within the piston chamber 106B and has an hemispherical end 111A where it makes contact with piston 109.

A packing washer 112 is disposed between body 101/101A and the locking member 108 at one end of the bore 101B, and at the other end thereof an helical spring 113 is housed by cap 103. The foot valve is made in the form of a separate screwed-in unit consisting of valve body 114, provided with an axial recess 115 and a cap 116 which holds in position a light spring 119 which spring presses ball 117 against an orifice 118 formed in the lower end of valve body 114. The delivery valve orifice 120 is closed by ball 117A controlled by gravity, and delivers into chamber 102A and thence to a lateral air passage 121, provided for priming purposes. The spring 113 presses against the extended reduced tail or end 122 of piston 111 by means of a flanged abutment piece 123. Spring 124 which abuts at one end on plug 105 presses a suitably large ball 125 against its seat to close valve chamber 102A. Member 126 is a device for enabling air which may be trapped in the delivery valve assembly between balls 117A and 125, to be released from the system. A cap 127, screw 127A and ball 128 seal air passage 121. Sealing is effected by virtue of the fact that screw 127A presses ball 128 against the end of the air or bleeder passage 121. Screw 127A is drilled axially and the end of this screw adjacent to the ball is cut or slotted as to prevent the ball sealing this drilling.

When the device is used, cap 127 is removed and replaced by a short length of pipe. Member 127A is then unscrewed two or three turns. This opens the cavity between 125 and 117A to atmosphere allowing entrapped air to escape. A certain amount of fluid also flows and the object of this construction is to enable the escaping fluid to be collected in a convenient container and thus to avoid fouling the pump body and the floor underneath. Opposite the lower end of passage 101E is an orifice 129 sealed by screw 130 or by other suitable means. Washers 131, 132, 133, 134 and 135 seal the closures effected by members 104, 103, 106, 127 and 105. A spindle 136 carries a cam 137 which operates plunger 109 through a follower plate 137A provided to avoid lateral thrust on the plunger.

The pump operates in the normal manner. Spring 113 maintains the two pistons 109, 111 in contact causing them to function as one member. Rotation of the cam 137 drives the two pistons forward, compressing spring 113 and caus-

ing, owing to the difference in piston diameters, a reduction in volume of the free space within the piston chamber 106A, 106B and causing a portion of the fluid contained in this space to be forced past the delivery valves 117A, 125. At the end of the delivery stroke further movement of the cam allows spring 113 to push the two pistons in the reverse direction causing an enlargement of the piston chamber volume which results in fluid passing the foot valve 117 and entering this space.

The movement of the tail of piston 111 into and out of the spring chamber 101F will similarly cause a variation in the volumetric contents of that chamber. Passage 101E permits a free flow of fluid from the suction side of the system into and out of this chamber 101F thus preventing the building up of excessive pressure therein or the creation of a partial vacuum which might prevent the pistons following the cam 137 during the outward stroke.

The advantages attaching to such an arrangement of pistons are several. The manufacture of two or more separate pistons each of which having only one accurate working diameter is an easier and cheaper operation than the production of a multiple unit having two or more cylinders of accurate diameter which must, by necessity, be truly concentric and in perfect axial alignment throughout the length of the member.

Again with regard to the bores in the piston chambers, concentricity and, within wide limits, axial alignment is immaterial when our system of piston construction is employed and this fact greatly reduces the cost of production of the member concerned.

Further, the accurate fitting of two or more separate pistons into their appropriate bores is a simple matter, whereas with a multiple integral piston unit it is extremely difficult to be sure that each section fits correctly into and along its appropriate bore.

The described method of construction is of particular value when it is desired to produce a pump of known displacement, which displacement will be consistent under widely varying conditions of pressure and viscosity and more especially if that displacement is small.

It will be evident that a piston assembly may be made up of more than two piston units, that valves other than indicated in the drawing may be employed, and that the constructional details may be varied in many ways without departing from the scope of the invention.

We are aware that Specification No. 567,037 claims a reciprocating pump, wherein the pumping operations are carried out by means of a plunger, which is slidable in a cylinder and is adapted to leave a clearance space in one end of the cylinder at the end of the instroke, and a differential piston which is movable in the said clearance space and is of less diameter than the cylinder so that an annular space is left between the piston and the cylinder, and wherein the volume of liquid discharged per stroke is equal to the cross section of the annular space multiplied by the effective stroke of the plunger and is therefore less than it would normally be without the introduction of the said differential piston.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. A differential piston construction wherein the pistons of different diameters are separate members and the piston of the larger diameter abuts directly on the piston of smaller diameter, means being provided for pressing the pistons together in operational connection, the pistons sliding in cylindrical piston chambers or bearings of suitable bore, and wherein the piston of smaller diameter has a hemispherical end where it makes contact with the large piston or *vice versa*.

2. A differential piston construction according to Claim 1 wherein at the junction of the two piston chambers suitable inlet and outlet orifices, ducts and valves are provided.

3. A differential piston construction according to either of Claims 1 and 2 wherein the free end of the piston of smaller diameter abuts on a compression return spring suitably housed and tensioned to keep the pistons always in contact.

4. A differential piston construction according to Claim 3 wherein a cam acts on the free end of the piston of larger diameter against the action of the beforementioned spring.

5. A constructional arrangement comprising differential pistons such as are used in certain types of plunger pumps substantially as described and illustrated with reference to the accompanying drawing.

Dated this 14th day of April, 1943.

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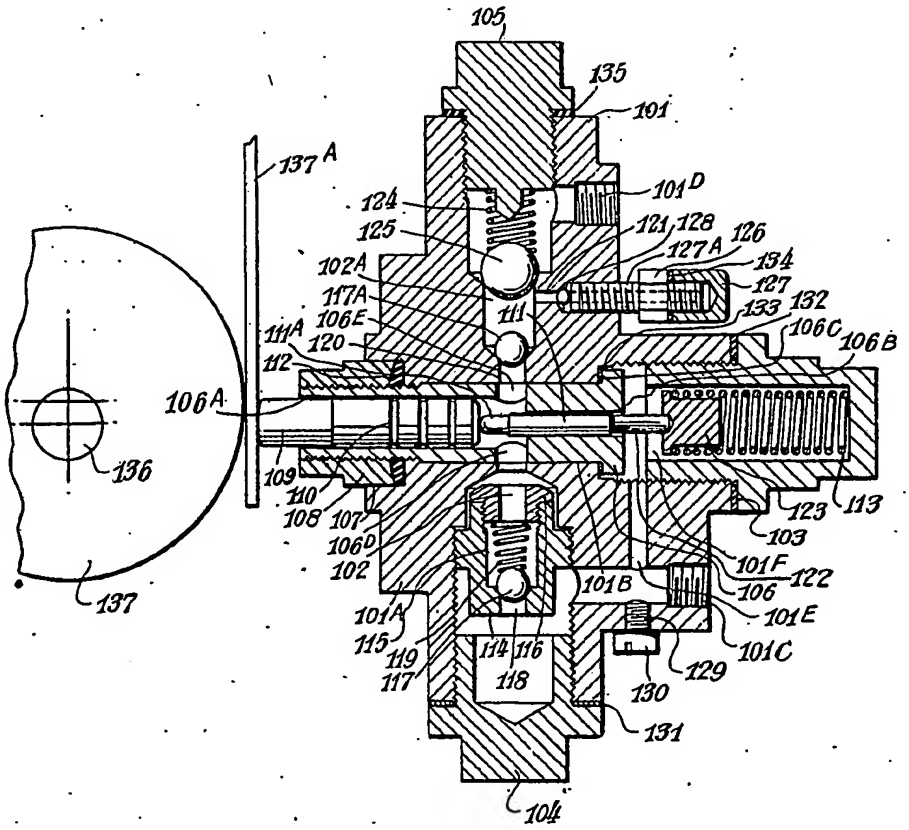
Chartered Patent Agents.

Leamington Spa: Printed for His Majesty's Stationery Office, by the Courier Press.—1945.



[This Drawing is a reproduction of the Original on a reduced scale.]

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